PROC. R. SOC. VICT. vol. 95, no. 1, 33-37, March 1983

THE GENUS *BRACHIONUS* (ROTIFERA: BRACHIONIDAE) IN AUSTRALIA, WITH A DESCRIPTION OF A NEW SPECIES

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Abstract: *Brachionus kostei* sp. nov. from waters of the Goulburn River, Victoria, is described and figured. It has affinities with the *B. urceolaris* group. Also described and figured is *B. forficula*, a new record for Australia. This Queensland species shown minor variations from the typical form. Twenty-two species and twenty-two subspecies/varieties of *Brachionus* from Australian waters are listed, with known distributions.

Although often the most abundant animals in Australian fresh waters, rotifers were neglected systematically and ecologically for almost 70 years following the work of Anderson, Shephard and others in the late 19th to early 20th century. With recent increased interest in freshwater ecology, and the recognition of the importance of rotifers in the trophic structure of Australian waters, there has been a proliferation of literature. In the last five years the number of recognised species has doubled, the known distribution of taxa hitherto recorded only from the Northern Hemisphere has been considerably extended, and endemic species in several families have been described (Sudzuki & Timms 1977, 1980; Shiel & Koste 1979, in press; Koste 1979, 1980a, b, 1981; Koste & Shiel 1980a, b, c, 1983; Green 1981; Shiel 1981 a, b; Walker 1981; Shiel, Walker & Williams 1982; Timms 1982; Brock & Shiel in press; Dussart *et al.* in press; Koste, Shiel & Brock in press; Tait, Shiel & Koste in press). In this paper, *Brachionus kostei* sp. nov. is described from Victorian waters, a local variant of *B. forficula* from Queensland is recorded for the first time from the continent, and the status of the cosmopolitan genus *Brachionus* in Australian inland waters is reviewed

SYSTEMATICS

Brachionus kostei sp. nov.

Figs 1, 2

Type Material: Eleven loricate females, sample number 865 Shiel collection.

Holotype: Loricate female, sample 865, collected 19 January 1982 by R. J. Shiel, Koste collection, genus *Brachionus* (11) No. 1.

Paratype: Numbers 2-3 (date and place of collection as for holotype) will be lodged in the South Australian Museum.

Type Locality: Sheepwash billabong, adjacent to Goulburn Valley highway near Molesworth, Victoria at 145°31'20"E, 37°10'20"S.

Description: Pear-shaped lorica distinguished from other *Brachionus* forms (e.g., *B. urceolaris* or *B. leydigii rotundus*) through six strong pointed occipital and two characteristic foot-opening spines. Dorsal lateral and median apical spines relatively long, foot-opening spines somewhat convoluted (see Fig. 2b). Dorsal lorica (Fig. 1a) patterned with two unpaired median pentagonal facets, single triangular frontal panel below median spines, two lateral quadrangular-spherical panels. Pectoral or mental border of ventral lorica excised at margins rising to two blunt spines flanking medial U-shaped sinus (Fig. 1b). Striking ornamentation of ventral lorica behind this sinus: two cuticular ridges with granular borders run posteriorly, diverging slightly to lorica midpoint, ending in a panel enclosed by two large convex and three small concave arches.

Measurements: Lorica length 108-140 μm, lorica width 110-115 μm, lorica height 55-65 μm, foot-opening ventral 22-25 μm, dorsal 12-15 μm.

Ecology: The waters of Sheepwash billabong are of low conductivity (<50-200 μS cm^{-1}), magnesium bicarbonate dominated, commonly of pH 7.0-7.7, and of high transparency (<0.2-17 NTU), reflecting groundwater inflows from the relatively high water table, or from the nearby Goulburn River in times of flood (Shiel 1981). The assemblage with the new species comprised: abundant dinoflagellates (*Ceratium* sp.), monogonont Rotifera [*Ascomorpha saltans* Bartsch, *Asplanchna priodonta* Gosse, *A. herricki* De Guerne, *A. brightwelli* (Gosse), *Keratella tropica* (Apstein), *K. cochlearis* (Gosse), *Lecane bulla* (Gosse), *Polyarthra* cf. *vulgaris* Carlin and *Trichocerca similis* (Wierzejski)], Copepoda (*Boeckella minuta* Sars, *Tropocyclops* Kiefer n.sp.) and Cladocera (*Diaphanosoma unguiculatum* Guerney, *Daphnia carinata* King s.l., *D. lumholtzi* Sars, *Ceriodaphnia laticaudata* Muller and *C. cornuta* Sars). Co-occurrence of congeners in limnetic and littoral microfauna is typical of billabongs in this region (cf. Shiel 1976).

Etymology: The species is named after Dr Walter Koste, Quakenbrück, West Germany, in recognition of more than 30 years dedication to rotifer systematics and ecology.

Discussion: The new species belongs to the Formenkreis *urceolaris* (see Koste 1978, p. 76 and 1979, p. 239). It is characterised in particular by its conspicuously pointed spines, which are found in the following species groups: 1, *Brachionus nilsoni* Ahlstrom 1940 (cf. Ahlstrom 1940, Table 17: 1-5; 2, *Brachionus variabilis* (Hempel 1896); and 3, *Brachionus novaezealandia* (Morris 1913).

The first of these is constant in form, and is

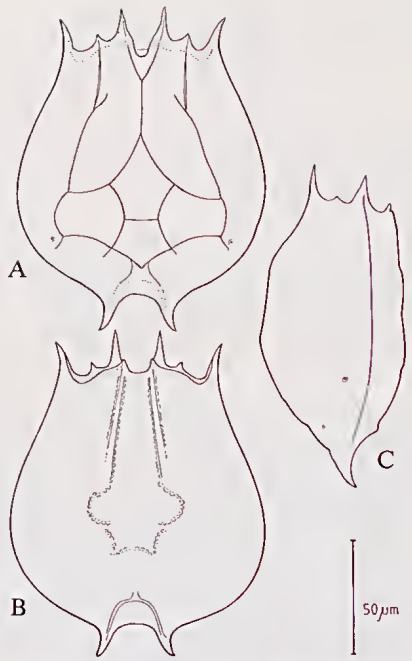

Fig. 1—*Brachionus kostei* sp. nov. A, lorica dorsal. B, lorica ventral. C, lorica lateral.

distinguished from the new species through short occipital spines, lack of median apical ventral spines and a ventral widely notched foot-opening (cf. Koste 1978). *B. variabilis* has very variable posterior spines. However, there is a constant and characteristic squamous projection over the foot-opening of the dorsal plate. This caudal process is absent in the new species (cf. Koste 1978, p. 80, fig. 9—5a-f). *Brachionus novaezealandia*, which shows many modifications, particularly in the construction of the submedian and lateral occipital spines and in the posterior spines (even within the same population), is always elongated in general form. Moreover, the median spines are always strikingly longer than the other apical spines. Facettation of the dorsal plate as seen in *B. kostei*, or ornamentation of the ventral plate, is previously unknown (cf. Koste 1978, 1979).

Brachionus forficula Wierzejski 1891

Fig. 3

DESCRIPTION: Morphology generally in accord with the description by Ahlstrom (1940). Characteristic four occipital spines, all sharply pointed. Two median spines slightly shorter flanking a V-shaped sinus. Mental margin excised laterally, undulate submedian sections with shallow medial depression (Fig. 3a). Stout posterior spines, subequal, pointed. Kneelike swelling on inner margin (cf. Fig. 3b) absent. Foot-opening ventral. Lorica lightly granulated.

MEASUREMENTS: Total length 208 µm, width 93 µm, anterior spines (median) 10 µm, (lateral) 16 µm, posterior spines (right) 82 µm, (left) 90 µm.

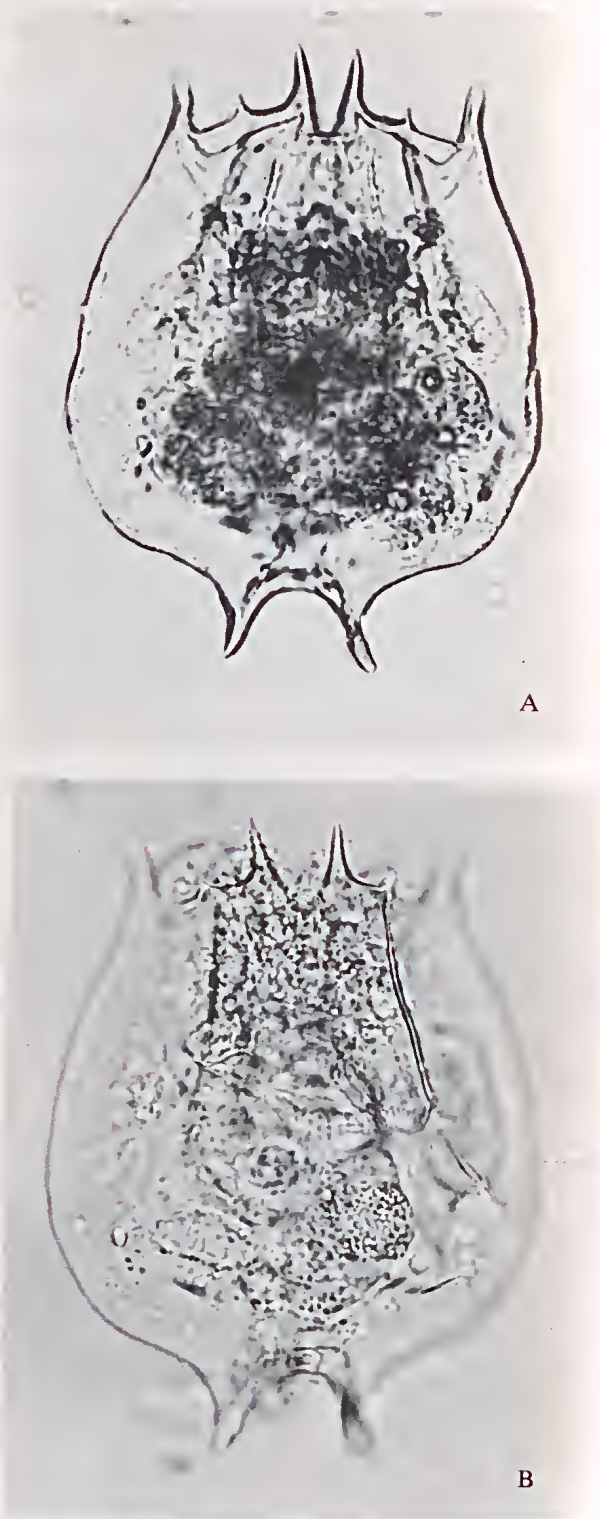

Fig. 2—*B. kostei* sp. nov. A, lorica ventral showing median sinus on mental margin and marked torsion of posterior spines. B, lorica dorsal.

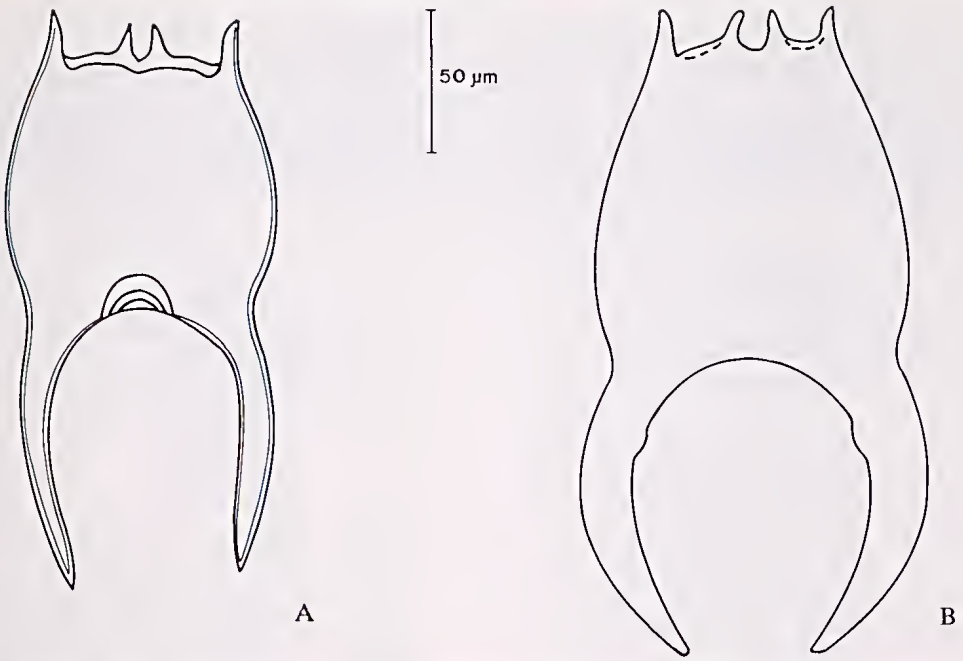

Fig. 3—*Brachionus forficula* Wierzejski A, ? ecotype from Queensland. B, typical adult form (redrawn after Koste 1978).

Discussion: The variability of this species was described by Ahlstrom (1940), who noted that the swellings on the posterior spines may be absent on reduced forms. While the Queensland specimen resembles *B. forficula minor* Voronkov in this respect (see Kutikova 1970, figs 941a, b), it is in the upper third of the size range 106-256 µm reported by Ahlstrom. In the absence of further comparative material, the specimen is regarded here as an ecotype.

Characteristic of subtropical waters (Ahlstrom 1940), this rotifer has not previously been recorded from the continent. A single individual was recorded from a limnetic tow made by H. Midgely from Enoggera Creek Reservoir near Brisbane. It was forwarded by Dr. B. V. Timms, Avondale College, Cooranbong, N.S.W.

BRACHIONUS IN AUSTRALIA

In a review of the family Brachionidae, Pejler (1977) listed 13 species of *Brachionus* from Australian waters. Of these, *B. dimidiatus* (Bryce) was recorded from the New Hebrides (Russell 1957) and *B. zahniseri* Ahlstrom from New Zealand (Russell 1959). The remaining species were of wide distribution; no endemic taxa were recorded. *B. dichotomus* and *B. lyratus*, described by Shephard (1911) from Victoria, were omitted following Ahlstrom's (1940) revision of the genus, in which these species were regarded as probably synonymous with the widely distributed *B. falcatus* and *B. angularis* respectively.

With the descriptions of *B. baylyi* Sudzuki & Timms 1977, *B. keikoa* Koste 1979, *B. pinneenaus* Koste & Shiel in press, *B. kostei* sp. nov. and the rediscovery of *B. dichotomus* and *B. lyratus* (Koste & Shiel 1980 a, b, 1983; Sudzuki & Timms (1980) six endemic species are known from the continent. A further five new records and 22 subspecies or varieties, some of which apparently are endemic, were recorded in a study of the zooplankton of the Murray-Darling river system (Shiel, 1981a). All recognised taxa are listed in Table 1, with authority and known distribution.

The distributions in Table 1 represent only a small fraction of Australia's inland waters, and the list undoubtedly will be expanded with further investigations. The following trends are apparent: species recorded elsewhere as cosmopolitan also are pancontinental in Australia (e.g., *B. calyciflorus, B. angularis, B. plicatilis*). This group shows the greatest tolerance to variations in water quality, although, in accord with observations on the genus elsewhere, they are predominantly alkaline water species. *B. keikoa* is the only endemic species commonly found in alkaline waters, although *B. pinneenaus* is a rare component of alkaline waters in Western Australia (Koste *et al.* in press). The saline water species *B. plicatilis* shows some geographical variation, with the subspecies *colongulaciensis* confined to southeastern Australia (including Tasmania, at 42°S the southernmost record of the genus, cf. Pejler 1977), and the typical form across the continent (cf. Brock & Shiel in press, Koste *et al.* in press). *B. falcatus*, considered to be a cosmotropical form, occurs throughout the Murray-Darling basin to 37°S. The remaining taxa are restricted to small geographical areas or single habitats, particularly billabongs. This group occupies neutral-acid waters, commonly of low conductivity, e.g., *B. urceolaris sericus* (pH 3.25) (Tait *et al.* in press). Notably, dwarf

TABLE 1

SPECIES OF *BRACHIONUS* RECORDED FROM AUSTRALIAN WATERS

Ssp and varieties are shown below each recognised species; * indicates apparently endemic taxa. A key to reference sources is given below. Predominant habitat is shown by R = river, L = lake/reservoir, B = billabong.

Key to sources: [1]Sudzuki & Timms 1977; [2]Pejler 1977; [3]Koste 1979; [4]Shiel 1979; [5]Shiel & Koste 1979; [6]Koste & Shiel 1980a; [7]b; [8]c; [9]Koste 1981; [10]Green 1981; [11]Shiel, Walker & Williams 1982; [12]Koste & Shiel 1983; [13]Brock & Shiel in press; [14]Koste, Shiel & Brock in press.

Taxon		Source	Distribution	Habitat
1.	*B. angularis* Gosse	2	Cosmopolitan	R, L
	bidens Plate	5	L. Mulwala, Vict.	
2.	**B. baylyi* Sudzuki & Timms	1	Myall Lakes, N.S.W.	
3.	*B. bidentata* Anderson	2	Cosmopolitan	L
	testudinarius Jakubski	5	E. Aust., N.T.	L, B
	jirovci Bartos	5	R. Murray, S.A.	R
	**minor* Koste & Shiel	8	R. Murray, S.A.	R
4.	*B. budapestinensis* (Daday)	4	Murray-Darling	R, B
5.	*B. calyciflorus* Pallas	2	Cosmopolitan	R, L
	amphiceros Ehrenberg	5, 13	Pancontinental	R, L
	aneuriformis Brehm	5	E. Aust.	R, L
	**gigantea* Koste & Shiel	7	Menindee Lakes, N.S.W.	
6.	*B. caudatus* Barrois & Daday	2	E. Aust.	R, L
	austrogenitus Ahlstrom	11	lower R. Murray, S.A.	
	personatus Ahlstrom	9	Magela Creek, N.T.	B
7.	**B. dichotomus* Shephard	6	E. Aust., N.T.	B
	**reductus* Koste & Shiel	6	E. Aust., N.T.	B
8.	*B. dimidiatus* (Bryce)	8	Wodonga, Vict.	B
9.	*B. diversicornis* (Daday)	4	E. Aust.	R, L
10.	*B. falcatus* Zacharias	2	Pancontinental	R, L, B
	**reductus* Koste & Shiel	12	Magela Creek, N.T.	B
11.	*B. forficula* Wierzejski	this paper	Tropical Qld.	L
12.	**B. keikoa* Koste	3	Darling Basin	R, B
13.	**B. kostei* n. sp.	this paper	Goulburn	R, B
14.	*B. leydigii* Cohn	2	E. Aust.	B
	rotundus (Rousselet)	5	R. Murray	B
15.	**B. lyratus* Shephard	8	E. Aust.	B
16.	*B. novaezealandia* (Morris)	2	Cosmopolitan	R, L
17.	*B. patulus* Muller	5, 10	E. Aust., N.T.	L, B
18.	**B. pinneenaus* Koste & Shiel	14	S.W. W. Aust.	R
19.	*B. plicatilis* Muller	2, 13	Cosmopolitan	saline L
	**colongulaciensis* Koste & Shiel	7	Vict., Tas.	saline L
20.	*B. quadridentatus* Hermann	2, 10	Cosmopolitan	L, B
	melheni Barrois & Daday	5	E. Aust.	L, B
	brevispinus (Ehrenberg)	8	L. Boort, Vict.	
	cluniorbicularis Skorikow	8	Wodonga, Vict.	B
	*undescribed dwarf form	14	W.A., N.T.	B
21.	*B. urceolaris* (Muller)	2	Cosmopolitan	
	bennini (Leissling)	4	R. Murray	R, B
	nilsoni (Ahlstrom)	5	R. Murray	R, B
	rubens (Ehrenberg)	2	R. Murray	R, B
	sericus (Rousselet)	12	N.T.	B
	sessilus (Varga)	8	Wodonga, Vic.	B
22.	*B. variabilis* (Hempel)	8	R. Murray	B

forms of several species (cf. Table 1) occur in these extreme biotopes.

There is no published ecological work on species' tolerances of Rotifera in Australian waters. However, there is some evidence that they counter the problems of living in billabongs (cf. Tait 1981, Koste & Shiel in press) by rapid generation times, the environmental cues for which may not be seasonal. Thus, the appearance of a species may be confined to weeks or days in appropriate conditions, and large population densities (>50 000 individuals l^{-1}) may be reached (Tait *et al.* in press).

Distinct habitat preferences or requirements produce species associations characteristic of each area, e.g., Alligator River billabongs have, in addition to cosmopolitan *Brachionus*, one or more of: *B. falcatus, B. dichotomus, B. caudatus personatus, B. urceolaris sericus* and *B. budapestinensis*. River Murray billabongs may have the cosmopolitan taxa, plus *B. quadriden-*

tatus, B. bidentata, B. urceolaris ssp. and *B. variabilis*, while the river proper may carry a mixed assemblage plus *B. calyciflorus, B. diversicornis* and (lower Murray only) *B. keikoa*. Western Australian waters, with higher salinities, commonly have only *B. calyciflorus* or *B. plicatilis* (cf. Brock & Shiel in press), although the work of Koste *et al.* (in press) suggests that ephemeral waters may carry rich rotifer communities.

ACKNOWLEDGEMENTS

Dr Walter Koste is thanked for verifying the new record from Victoria. Dr Brian Timms, Avondale College, Cooranbong, N.S.W. provided the material from Queensland, and Prof. C. H. Fernando, University of Waterloo, Ontario, brought this collection to my attention.

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